

REMARKS**INTRODUCTION:**

In accordance with the foregoing, claims 1, 5, 8 and 13 have been amended. No new matter is being presented, and approval and entry are respectfully requested.

Claims 1, 4, 5, 7, 8, and 11-13 are pending and under consideration. Reconsideration is respectfully requested.

OBJECTIONS TO THE DRAWINGS:

In the Office Action, at page 2, the drawings were objected to. The independent claims of the present invention have been amended as set forth below. Therefore, the outstanding drawing objections should be resolved.

Independent claim 1, has been amended to recite, as is shown in FIGs. 4A and 4B: "A bandpass filter, comprising an inductor having a non-gapped core that consists essentially of an Fe-based amorphous metal alloy ribbon, a linear BH loop, and has a ~~substantially~~ constant permeability, ~~± about 5%,~~ over a frequency range of about 1 to 1000 kHz." Independent claims 5, 8 and 13 have been amended in similar fashion. Since claims 4, 7, and 11 depend from amended independent claims 1, 5, 8, respectively, claims 4, 7 and 11 include the features of amended claims 1, 5 and 8. This amendment is based on paragraphs [0036]-[0037] of the specification of the published application of the present invention, which recites:

[0036] FIG. 4A is a graph depicting the functional relationship between core permeability and applied field frequency for a bandpass filter of the invention. An alternating current (AC) signal is applied to a bandpass filter having a core consisting essentially of an Fe-base amorphous metal alloy with a permeability of approximately 700. The frequency is varied over a range of 1-10,000 kHz while the permeability is measured. The graph indicates that the permeability is constant up to about 1000 kHz range. The permeability then gradually decreases linearly from 700 to 20 as the frequency is varied from 1000 kHz to 20,000 kHz. (emphasis added)

[0037] FIG. 4B is a graph depicting core permeability as a function of applied field strength for a bandpass filter of the invention. A bandpass filter having a Fe-based core with a permeability of approximately 700 is subjected to a magnetic field H that is varied over a range of 0 to 35 Oe while the permeability of the core is measured. The graph indicates that the permeability does not vary appreciably within a magnetic field H range of approximately 0 to 15 Oe. The permeability gradually decreases from 700 to 300 in a linear fashion as the magnetic field H is varied past 17 Oe. The ferromagnetic core can

be used in a filter circuit as part of a communications circuit such as DSL. The ferromagnetic core exhibits a magnetic permeability that is linear as the frequency and magnetic field strength is varied over a range that is representative of a communications application such as DSL. (emphasis added)

Hence, it is clear that the statement “a constant permeability over a frequency range of about 1 to 1000 kHz” does not indicate that the permeability has a single value over a frequency range of about 1 to 1000 Hz, but rather indicates that the permeability does not vary appreciably over such a range.

Thus, it is respectfully submitted that, in view of the amendment to independent claims 1, 5, 8, and 13 of the present invention, the drawings show every feature of the invention specified in the claims and are in compliance with CFR 1.121(d).

Thus, reconsideration and withdrawal of the outstanding objections to the drawings are respectfully requested.

REJECTION UNDER 35 U.S.C. §112:

A. In the Office Action, at pages 2-3, claims 1,4, 5, 7-8, 11 and 13 were rejected under 35 U.S.C. §112, first paragraph, as failing to comply with the written description requirement. This rejection is traversed and reconsideration is requested.

Independent claim 1, has been amended to recite, as is shown in FIG. 4A: “A bandpass filter, comprising an inductor having a non-gapped core that consists essentially of an Fe-based amorphous metal alloy ribbon, a linear BH loop, and has a ~~substantially~~ constant permeability, ~~± about 5%,~~ over a frequency range of about 1 to 1000 kHz.” Independent claims 5, 8 and 13 have been amended in similar fashion. This amendment is supported, for example, by paragraph [0036] of the specification of the invention.

Hence, amended independent claims 1, 5, 8, and 13 are submitted to comply with the written description requirement and to be allowable under 35 U.S.C. §112, first paragraph. Since claims 4, 7, and 11 are submitted to comply with the written description requirement and to be allowable under 35 U.S.C. §112, first paragraph, for at least the reasons amended independent claims 1, 5, and 8 comply with the written description requirement and are allowable under 35 U.S.C. §112, first paragraph.

B. In the Office Action, at page 3, claims 1,4, 5, 7-8, 11 and 13 were rejected under 35 U.S.C. §112, first paragraph, as failing to comply with the enablement requirement. This rejection is traversed and reconsideration is requested.

Independent claim 1, has been amended to recite, as is shown in FIG. 4A: "A bandpass filter, comprising an inductor having a non-gapped core that consists essentially of an Fe-based amorphous metal alloy ribbon, a linear BH loop, and has a ~~substantially~~ constant permeability, ~~± about 5%,~~ over a frequency range of about 1 to 1000 kHz." Independent claims 5, 8 and 13 have been amended in similar fashion. This amendment is supported, for example, by paragraph [0036] of the specification of the invention.

Hence, amended independent claims 1, 5, 8, and 13 are submitted to comply with the enablement requirement and to be allowable under 35 U.S.C. §112, first paragraph. Since claims 4, 7, and 11 depend from amended independent claims 1, 5 and 8, respectively, claims 4, 7 and 11 are submitted to comply with the enablement requirement and to be allowable under 35 U.S.C. §112, first paragraph, for at least the reasons amended independent claims 1, 5, and 8 comply with the enablement requirement and are allowable under 35 U.S.C. §112, first paragraph.

REJECTION UNDER 35 U.S.C. §103:

In the Office Action, at pages 3-4, claims 1, 4-5, 7-8, and 11-13 were rejected under 35 U.S.C. §103(a) as being unpatentable over applicant's admitted prior art (hereafter, AAPA) in view of Nakagawa et al. (JP 06-151143; hereafter Nakagawa). The reasons for the rejection are set forth in the Office Action and therefore not repeated. The rejection is traversed and reconsideration is requested.

It is respectfully submitted that claim 1 of Nakagawa (JP 06-151143), in column 1, line 2-5, provides "*a low loss magnetic core featuring DC squareness (B_r/B_s) ratio less than 50%, coercivity between 0.2 and 10 Oe and squareness (B_r/B_1) at 1 MHz ranging from 5 and 30 %*". Furthermore, in paragraph [0001] on an area of industrial use, it is stated that "*this (Nakagawa) invention relates to a magnetic core for a switching power supply showing low core loss especially in high frequency range of MHz level*". In paragraph [0006] also found in Column 1 of JP 06-151143, it is stated that "*a core of this (Nakagawa) invention requires a low loss and simultaneously a high coercivity*". Thus, it is clear that the Nakagawa product intended for use in a switching power supply is totally a different product than a product intended for use in a bandpass filter of the present invention.

A switching power supply does not need a bandpass filter of the present invention. Likewise a bandpass filter of the present invention cannot utilize a core of Nakagawa, because a Nakagawa core does not give low (including zero) resonance frequency shifts as depicted in Fig. 5 of the present application. A "high coercivity" needed in a Nakagawa core results in a highly non-linear magnetic response which does not lead to a linear BH relationship of Fig. 3 of the

present application for a wide range (e.g. ± 15 Oe) of an applied field.

In contrast to a high coercivity of Nakagawa core, a core of the present invention has a coercivity ~ 0.0 Oe (in which a field resolution is about 0.001) as Fig. 3 of the present application indicates. With this near-zero coercivity comes $B_r \sim 0$, and thus, a squareness ratio (B_r/B_s) of a core of the present invention is ~ 0 %.

In contrast to this, a Nakagawa core shows a squareness ratio ranging from 18% to 50% (see Table 2 of Nakagawa). Those skilled in the art know that a coercivity even as low as 0.2 Oe and a squareness ratio of as low as 18 % will never lead to a linear B-H behavior of a magnetic core. Nakagawa's need for a "high coercivity" arises from his need to expand the operational magnetic excitation range in which core's magnetic permeability is constant. As stated in paragraph [0008] in Column 2 of JP 06-151143, *"this (Nakagawa) invention intends to provide a core having a low loss and a high coercivity in high frequency region, together with a constant permeability in the operating magnetic excitation range"*. It is true that Nakagawa achieved a constant permeability, but in a very small range of ± 2 mOe as stated in line 14, in column 6 of Nakagawa. This small range of applied magnetic field of ± 2 mOe is 1/100 of the smallest coercivity (0.2 Oe) and 1/50,000 of the largest coercivity (10 Oe), respectively of the Nakagawa core (see Nakagawa Claim 1). A constant permeability of the Nakagawa core obtained for a small magnetic excitation with respect to core's coercivity is expected from any magnetic material as explained below.

Chapter 2 of "Physics of Magnetism" by Soshin Chikazumi, Professor of Physics, Institute for Solid State Physics, University of Tokyo, published by John Wiley & Sons, copyright 1964 (pages 15-17 of which are reproduced below for the convenience of the Examiner) states:

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Magnetization of a Ferromagnetic Body

2.1 Magnetization Curve

One feature of ferromagnetic substances is that they exhibit a fairly complex change in magnetization upon the application of a magnetic field. This behavior can be described by a magnetization curve (Fig. 2.1).

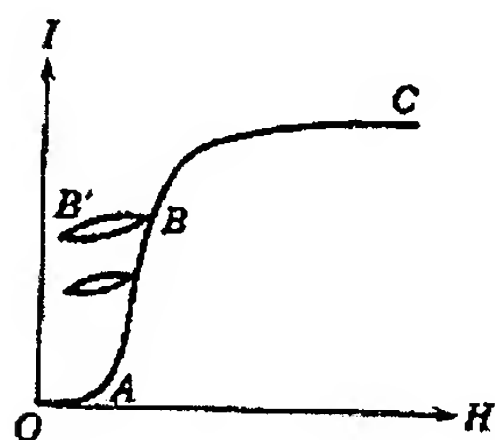


Fig. 2.1. Initial magnetization curve and minor loops.

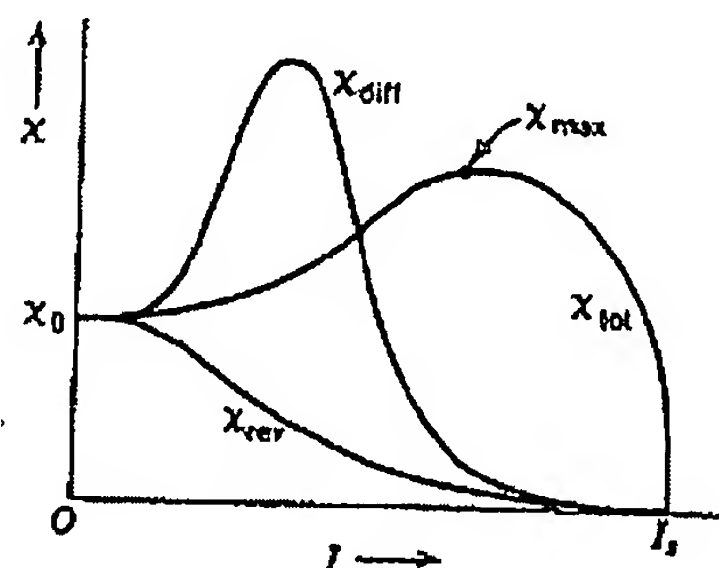


Fig. 2.2. Various kinds of magnetic susceptibilities as functions of the intensity of magnetization.

Starting from a demagnetized state ($I = H = 0$), the magnetization increases with an increase of the field along the curve $OABC$ and finally reaches the saturation magnetization which is normally denoted by I_s . In the region OA the process of magnetization is almost reversible; that is, the magnetization comes back to zero upon removal of the field. The

inclination of the curve OA is called the initial susceptibility χ_a . Beyond this region the processes of magnetization are no longer reversible. If the field is decreased from its value at point B , the magnetization comes back, not along BAO , but along the minor loop BB' . The inclination of BB' is called the reversible susceptibility χ_{rev} or the incremental susceptibility. The slope of each portion of the initial magnetization curve $OABC$ is called the differential susceptibility χ_{diff} , and the slope of the line which connects the origin O and each point on the initial magnetization curve is called the total susceptibility χ_{tot} . The maximum value of the total susceptibility, that is, the slope of the tangent line drawn from the origin to the initial magnetization curve, is called the maximum susceptibility χ_{max} ; it is a good measure of the average inclination of the initial magnetization curve. Changes in χ_{rev} , χ_{diff} , and χ_{tot} along the initial magnetization curve are shown in Fig. 2.2. Starting from the value of χ_a , χ_{rev} decreases monotonically, while χ_{diff} has a sharp maximum, and χ_{tot} goes through its maximum value χ_{max} and drops off at $I = I_c$. The difference between χ_{diff} and χ_{rev} represents the susceptibility due to irreversible magnetization; it is called the irreversible susceptibility χ_{irr} ; that is,

$$\chi_{diff} = \chi_{rev} + \chi_{irr} \quad (2.1)$$

If the magnetic field is decreased from the saturated state C (Fig. 2.3), the magnetization I is gradually decreased along CD , not along $CBAO$, and at $H = 0$ it reaches the finite value I_r ($= OD$), which is called the residual magnetization or the remanence. Further increase of the magnetic field in a negative sense results in a continued decrease of the intensity of magnetization, which finally falls to zero. The field at this point is called the coercive force H_c ($= OE$). This portion, DE , of the magnetization curve is often referred to as a demagnetizing curve. Further increase of H in a negative sense results in an increase of the intensity of magnetization in a negative sense and finally leads to a negative saturation magnetization. If the field is then reversed to the positive sense, the magnetization will change along FGC . The closed loop $CDEFGC$ is called the hysteresis loop.

Now we discuss the work necessary to magnetize a ferromagnetic substance. Suppose that the magnetization is increased from I to $I + \delta I$ under the action of a magnetic field H which is parallel to I . If we consider a cylindrical section of the magnetic substance whose length is l (parallel to I) and whose cross section is S , an increase of magnetization, δI , in the cylinder is attained by transporting the magnetic pole δIS through the distance l from the bottom to the top of the cylinder under the action of the force δISH . The work required for this transportation is $H \delta ISl$.

2.1 MAGNETIZATION CURVE

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Since the volume of the cylinder is Sl , the work necessary to magnetize a unit volume of the magnetic substance is given by

$$\delta W = H \delta I. \quad (2.2)$$

Then the work required to magnetize a unit volume from $I = I_1$ to I_2 is expressed by

$$W = \int_{I_1}^{I_2} H dI. \quad (2.3)$$

For example, the work required to magnetize the volume from a demagnetized state to saturation, I_s , is given by (2.3) by putting $I_1 = 0$ and $I_2 = I_s$.

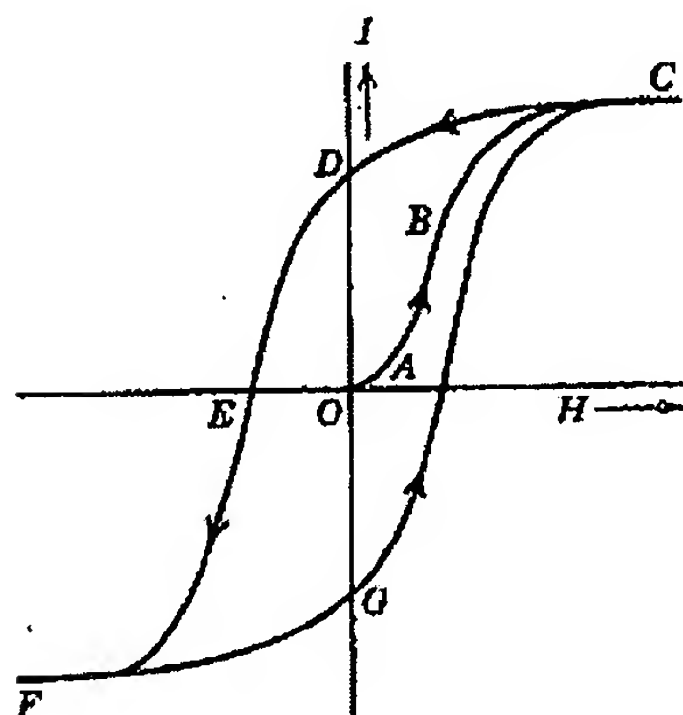


Fig. 2.3. Hysteresis loop.

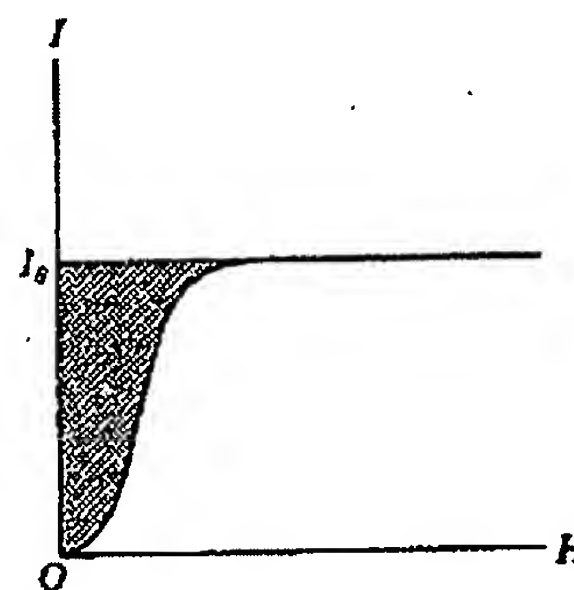


Fig. 2.4. Work required to saturate a unit volume of a ferromagnetic substance.

This is equal to the area surrounded by the ordinate axis, the line $I = I_s$, and the initial magnetization curve as shown in Fig. 2.4. The energy supplied by this work is partially stored as potential energy, and also partly dissipated as heat which is generated in the substance. During one cycle of the hysteresis loop the potential energy should return to its original value, so that the resultant work must be consumed as heat. This heat is called the hysteresis loss and is given by

$$W_h = \oint H dI, \quad (2.4)$$

which is equal to the area surrounded by the hysteresis loop.

Thus, the initial magnetization curve OA in Fig. 2.1. is relatively linear up a certain small magnetic excitation as indicated by the initial susceptibility (equivalent to permeability) χ_0 in Fig. 2.2. As explained in detail in Section 2.1 Magnetization Curve of Chapter 2 of Chikazumi's book, this magnetization is reversible as it is close to a linear response, which takes place well below a material's coercivity field OE as indicated in Fig. 2.3. Nakagawa's magnetic excitation level is 2 mOe which is about 1/100 of his lowest coercivity as mentioned above, and his resultant data

given in Fig. 2 of Nakagawa is expected. Generally when the coercivity is high, the relatively linear region becomes large. This general relationship which is well known to those skilled in the art was utilized by Nakagawa et al. Therefore, when the applied field exceeds the reversible magnetization region, magnetic permeability (or susceptibility) becomes non-linear. Hence, it is respectfully submitted that the Examiner is wrong by stating that "*Nakagawa et al. inherently discloses a linear B-H loop of the device and the substantially constant permeability exists for a field strength range approximately -15 to + 15 Oe.*" Nowhere in Nakagawa can one find such a disclosure. A core of the present invention shows a linear B-H loop for a much wider range of ± 15 Oe, whereas Nakagawa's core shows a similar relationship for an applied field range of only ± 2 mOe (± 0.002 Oe). Also, it is respectfully submitted that the Examiner was wrong by stating that "*Nakagawa et al further discloses the core having a permeability in a range of 400 and 1000 over a frequency range of 1 to 1000 kHz [figure 2]*" See Fig. 2 of Nakagawa, which shows his lowest permeability is clearly indicated at 700.

Further evidence that Nakagawa core cannot show a linear B-H loop for a wide applied field (e.g. ± 15 Oe) range is given in Tables 1 and 2 of Nakagawa, where coercivity ranges from 0.35 Oe to 3.7 Oe and squareness ratio (B_r/B_s) ranges from 18% to 50%. By knowing these coercivity and squareness ratio values, those skilled in the art conclude that a Nakagawa core shows a "round B-H loop" similar (shapewise) to the one with somewhat reduced B_r value depicted in Fig. 2.3 found in Chapter 2 of Chikazumi's book quoted above. The "round B-H loop" with a large coercivity of Nakagawa is very different from a linear B-H loop with near-zero coercivity of Fig. 3 of the present application.

Hence, it is respectfully submitted that it is NOT obvious to one having ordinary skilled in the art at the time the invention was made to use the magnetic core of Nakagawa in AAPA for the purpose of improving magnetic characteristics. Thus, it is respectfully submitted that independent claims 1, 5, 8 and 13, as well as dependent claims 4, 7 and 11 which depend therefrom, are patentable under 35 U.S.C. §103(a) over applicant's admitted prior art (AAPA) in view of Nakagawa et al. (JP 06-151143).

CONCLUSION:

In accordance with the foregoing, it is respectfully submitted that all outstanding objections and rejections have been overcome and/or rendered moot, and further, that all pending claims patentably distinguish over the prior art. Thus, there being no further outstanding objections or rejections, the application is submitted as being in condition for allowance which action is earnestly solicited.

If the Examiner has any remaining issues to be addressed, it is believed that prosecution can be expedited by the Examiner contacting the undersigned attorney for a telephone interview to discuss resolution of such issues.

If there are any underpayments or overpayments of fees associated with the filing of this Amendment, please charge and/or credit the same to our Deposit Account No. 19-3935.

Respectfully submitted,

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